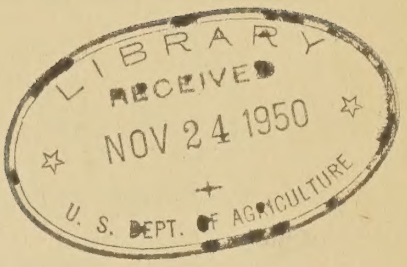
POULTRY HOUSING

A selected list of references



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FOREWORD

Previous studies by the Poultry Housing committees of the American Society of Agricultural Engineers have indicated that almost 500 different designs are now recommended by the various states. A study of climatic conditions, poultry breeds, and different practices in poultry management fail to reveal a need for so many different designs.

This bibliography has been prepared as the first step in simplification of poultry house construction, which must be based on basic requirements of feeding, breeding, labor and optimum environment for maximum and economical production. The references selected are but a partial list of current literature, but are thought to contain a representative sample of the problems to be met in the improvement of poultry housing in the various sections of the country.

The classification shown in the index has been prepared for the convenience of the research worker. Many of the references may appear to be placed in the wrong classification as judged by the subject title, but they have been classified in accordance with some of the most important usage of the subject matter for our purpose. Thus the nutritionist, physiologist or poultry husbandrymen will obviously classify the same bulletins under different headings. It is hoped that all these purposes may help to advance the simplification and improvement of poultry housing suitable for local conditions.

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1. Poultry General.

a. Economics and Markets.

Anonymous. How the weather, the cost of storage eggs, and the reserves in storage influence the winter egg market. United States Egg and Poultry Magazine. v.34. p.17-21, 64. September 1928

Hauver, W. E. and others. Economic study of 99 poultry farms in Maryland. College Park, Md., 1936. 35 p. Maryland. Agricultural Experiment Station. Bulletin no.397. Analysis is made of the effects on profits of type of poultry enterprise, size of business, eggs produced per hen, capital turnover, use of feed, use of labor, selling price of eggs, and cost of producing eggs. Recommendations are made as to size of business, rate of egg production, diversity of enterprises, and efficiency in the use of labor and capital and in marketing.

Kempster, H. L. and Funk, E. M. Some production costs with growing chicks. Columbia, Mo., 1932. 12 p. Missouri. Agricultural Experiment Station. Bulletin no.313.

Manchester, A. W. and Fowler, H. C. Production and sale of poultry and eggs in three Rhode Island areas. Kingston, R. I.,1937. 31 p. Rhode Island. Agricultural Experiment Station. Bulletin no.262.

Poffenberger, P. R. and DeVault, S. H. Economic study of the broiler industry in Maryland. College Park, Md., 1937. 54 p. Maryland. Agricultural Experiment Station. Bulletin no.410. Comparisons are made of all farms and the 25 most profitable and the 25 least profitable farms for the 2 years, 1934-36. Farmers starting from 150 and 174 birds per 100 sq. ft. of floor space had the greatest profit.

Ternohlen, W. D. and others. Economic survey of the commercial broiler industry. Washington, D. C., 1936. 54 p. U. S. Department of Agriculture. Agricultural Adjustment Administration.

_____and Warren, E. L. Where chickens are grown for meat. Poultry Tribune. Northeast Edition. v.42. p.12, 33-34. December 1936.

Warren, E. L. and Wernel, M. T. Economic survey of the baby chick hatchery industry. Washington, D. C., 1935. 64 p. U. S. Department of Agriculture. Agricultural Adjustment Administration. Publication G33.

Wilham, O. S. Feed required to produce a dozen eggs. Goodwell, Okla., 1932. 7 p. Panhandle. Agricultural Experiment Station. Bulletin no.35.

b. Management, Range, Confinement.

Charles, T. B. and Stuart, H. O. Commercial poultry farming. Danville, Ill., Interstate Printing Co., 1936. 467p. Deals with incubation, hatchery practices, brooding practices, battery brooding and laying batteries, broiler production, capons and caponizing, principles of feeding, feeding chickens, feeding adult birds, rearing and range management.

Dearstyne, R. S. and others. Summer broiler production. Raleigh, N. C., 1936. 16p. North Carolina. Agricultural Experiment Station. Bulletin no.303. Tests showed that where an economic electric rate existed starting batteries were justified in broiler production. With adequate ventilation the batteries could be successfully used during the summer season.

Grace, N. H. Use of wax in the plucking of poultry. Ottawa, Canada, National Research Council, 1935. 19p.

Heywang, B. W. Poultry management in subtropical, semiarid climates. Washington, D. C., 1937. 19p. U.S. Department of Agriculture. Circular no.446.

Jeffrey, F. P. Wax picking of poultry. New Brunswick, N. J., 1937. 4p. New Jersey. Agricultural Experiment Station. Hints to poultrymen. v.24, no.6. The equipment required and the various steps to be followed in the wax picking of poultry on the farm are discussed. Certain difficulties encountered in applying this method and the volume of business which will justify the cost of necessary equipment are indicated.

Kennard, D. C. and Chamberlain, V. D. Egg production and livability of pullets as affected by management. Poultry Science. v.18. p.318-322. July 1939.

Thompson, W. C. Management of hens in laying cages. New Brunswick, N. J., 1939. 16p. New Jersey. Agricultural Experiment Station. Bulletin no.668.

Tomhave, A. E. Broiler feeding experiments. Newark, Del., 1938. 20p. Delaware. Agricultural Experiment Station. Bulletin no.210. Cost of producing broilers and financial returns on three different methods of management, p.13-17.

Wright, K. T. Profitable poultry management. East Lansing, Mich., 1938. 52p. Michigan. Agricultural Experiment Station. Special Bulletin no.294. The average net returns per laying flock for the years 1932-35 ranged from $5.16 to $200.55, averaging $74.66, and the labor returns per hour from $.14 to $.70 averaging $.37. Cost of chicks, feed, labor, etc., per 100 chicks was $38.41, and the average income from broilers, culled pullets, etc., was $16.02, making the average net cost for the 39 pullets raised $22.39.

c. Experimental Procedure.

Card, L. E. Application of nomographic methods to the field of poultry husbandry. Poultry Science. v.9. p.27-38. November 1929. Feed cost for egg production. Estimating egg prices. Margin realized in feeding capons. Cost of raising pullets.

Kennard, D. C. and Chamberlin, V. D. Five year's management tests with chicks and pullets. Poultry Science. v.15. p.230-234. May 1936. From studies at the Ohio Experiment Station data are presented on the egg production and the degree of mortality of groups of pullets confined, allowed to access to fresh range, and access to old or used range.

2. Nutrition.

a. Metabolism.

Anderson, R. J. and Kulp, W. L. Study of the metabolism and respiratory exchange in poultry during vitamin starvation and polyneuritis. Geneva, N. Y., 1922. 22p. New York. Agricultural Experiment Station. Technical Bulletin no.88. Also, in Journal of Biological Chemistry. v.52. p.69-89. May 1922.

Barott, H. G. Data on heat output of poultry from government research. Heating and Ventilating. v.36. p.27-29. March 1939.

_____ and others. Energy and gaseous metabolism of normal and deutectomized chicks between 10 hours and 100 hours of age. Journal of Nutrition. v.11. p.191-210. March 1936.

_____ and others. Heat production and gaseous metabolism of young male chickens. Journal of Nutrition. v.15. p.145-167. February 1938.

Benedict, F. G. and Riddle, Oscar. Measurement of basal heat production of pigeons. Journal of Nutrition. v.1. p.475-536. July 1929. Description of calorimeter. Effect of confinement upon heat production. Temperature is an important factor in determining the rate of heat production in doves and pigeons. Between 20°C (68°F.) and 30° C (86° F.) each degree modifies this rate approximately 2 per cent. Heat production day and night.

Brody, S. and others. Age changes in the heat production of chickens as measured by a graphic method; a preliminary report. Poultry Science. v.11. p.133-143. May 1932. Capons had a decidedly lower heat production than either cockerels or pullets.

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Fraps, G.S. and Carlyle, E.C. Utilization of the energy of feed by growing chickens. College Station, Texas, 1939. 44 p. Texas. Agricultural Experiment Station. Bulletin no.571.

Giese, H. and McCormick, F. J. Heat production of poultry under housing conditions. Agricultural Engineering. v.14. p.67-70. March 1933. Studies conducted at the Iowa Experiment Station.

Halpin, J. G. and others. Salt requirements of poultry. Poultry Science. v.15. p.99-103. March 1936.

Hogan, A. G. and Boucher, R. V. Nutritional requirements of the chick. Columbia, Mo., 1933. 24 p. Missouri. Agricultural Experiment Station. Research Bulletin no.198.

Kleiber, Max. Metabolism body size and age in baby chicks. Society for Experimental Biology and Medicine. Proceedings. v.38. p.793-796. June 1938. Two series of respiration trials were conducted on fasting baby chicks from 5 to 20 days of age. A steady increase in metabolic rate with increasing age was noted.

Lee, C. E. and others. Effect of substituting an all-mash and pellet ration for grain, mash and pellets on flock production, costs and returns. Poultry Science. v.18. p.375-377. September 1939.

Mitchell, H. H. and Haines, W. T. Basal metabolism of mature chickens and net-energy value of corn. Journal of Agricultural Research. v.34. p.927-943. May 15, 1927.

_____and others. Effect of age, sex, and castration on the basal heat production of chickens. Journal of Agricultural Research. v.34. p.945-960. May 15, 1927.

_____and Kelley, M.A.R. Estimated data on the energy, gaseous and water metabolism of poultry for use in planning the ventilation of poultry houses. Journal of Agricultural Research. v.47. p.735-748. November 15, 1933.

Phillips, V. W. and others. Growth and development with special reference to domestic animals. XXV. The course of energy and nitrogen metabolism in the domestic fowl during 48-day fasts. With special reference to temperament and training of the birds. Notes on 60-day fasts in swine. Columbia, Mo., 1932. 30 p. Missouri. Agricultural Experiment Station. Research Bulletin no.179.

Winchester, C. F. Growth and development with special reference to domestic animals. LI. Seasonal metabolic and endocrine rhythms in the domestic fowl. Columbia, Mo., 1940. 52 p. Missouri. Agricultural Experiment Station. Research Bulletin no.315.

b. Feeds.

Anderson, R. J. and Kulp, W. L. Study of the metabolism and respiratory exchange in poultry during vitamine starvation and polyneuritis. Geneva, N. Y., 1922. 22 p. New York. Agricultural Experiment Station. Technical Bulletin no.88. A fall in the intensity of metabolism is coincident with the decline in food consumption. Plan of experiment: 1. Normal basal metabolism. 2. Metabolism during digestion of grain and mash. 3. Metabolism during digestion of rice. 4. Metabolism during vitamin starvation. Heat production natural depending largely upon the activity of the birds. The heat production varied as much as 2 calories per hour in different experiments with the same hen.

Couch, J. R. and others. Vitamin D requirements of chickens grown in the absence of sunlight. College Station, Texas, 1935. 31 p. Texas. Agricultural Experiment Station. Bulletin no.521. In order to determine how much vitamine D was required in rations fed to chicks which did not have access to sunlight, four diets differing somewhat in their ingredients were studied. Chicks fed a ration containing the proper amounts of calcium and phosphorus apparently needed no additional vitamin D during the first 6 weeks, even in the absence of sunlight. Cockerels appeared to have a higher vitamin D requirement than pullets.

Davidson, J. A. Hopper-feeding grain to laying pullets: A comparison of continuous hopper feeding of grain with daily hand feeding. East Lansing, Mich., 1937. p.94-98. Michigan. Agricultural Experiment Station. Quarterly Bulletin no.20.

Fraps, G. S. and Carlyle, E. C. Relation of gain in weight to gain in energy content of growing chicks. Journal of Agricultural Research. v.59. p.777-781. November 15, 1939.

Heywang, B. W. and Morgan, R. B. Loss, during storage, of vitamin A from alfalfa leaf meals fed to chickens. Washington, D. C., 1939. 8 p. U. S. Department of Agriculture. Technical Bulletin no.632.

Murphy, R. R. and others. Vitamin D requirements of growing chicks and laying hens. State College, Pa., 1934. 24 p. Pennsylvania. Agricultural experiment station. Bulletin no.303.

Titus, H. W. Feeding of chickens. Washington, D. C., 1939. 22 p. U. S. Department of Agriculture. Farmers' Bulletin no.1841.

_____ and others. Growth of chickens as a function of feed consumption. Journal of Agricultural Research. v.48. p.817-835. May 1, 1934.

Waite, R. H. Feed consumption studies based on the six Maryland egg-laying contests. College Park, Md., 1934. 291-330 p. Maryland. Agricultural Experiment Station. Bulletin no.359. It was found that White Leghorn hens consumed 80.5 lb. of feed per head per year, Barred Plymouth Rocks 88.7 lb., and Rhode Island Reds 92.2 lb.

3. Bird Physiology and Reactions.

Kaupp, B. F. Poultry diseases, including diseases of other domesticated birds, with chapters on the anatomy and physiology of the fowl. Chicago, Ill., Alexander Eger, 1933. 444 p.

a. Breeding.

Burrows, W. H. and Byerly, T. C. Effect of certain groups of environmental factors upon the expression of broodiness. Poultry Science. v.17. p.324-330. July 1938.

Jull, M. A. and Maw, W. A. Determinations of the dressed, drawn, and edible percentages of various kinds of domestic birds. Scientific Agriculture. v.3. p.329-338. June 1923.

Landauer, W. and Upham, E. Weight and size of organs in frizzle fowl. Storrs, Conn., 1936. 42 p. Storrs. Agricultural Experiment Station. Bulletin no.210. Lessened water vaporization conserves body heat and is probably associated with the lack of enlargement of the lungs.

Marble, D. R. Breeding for poultry viability. State College, Pa., 1939. 38 p. Pennsylvania. Agricultural Experiment Station. Bulletin no.377. A 5-yr. program of selection of breeders from the most viable families of Single Comb White Leghorns and Barred Plymouth Rocks has resulted in improved viability in the rearing flock and a 50 percent reduction in mortality in the laying flock, with only a slight decrease in chick viability.

Waters, N. F. Inheritance of body-weight in domestic fowl. Kingston, R. I., 1931. 105 p. Rhode Island. Agricultural Experiment Station. Bulletin no.228.

b. Normal Functions, Respiration, Pulse, Temperatures.

Anonymous. [Poultry disease investigations, etc.]. Manhattan, Kan., 1938. p.114-119. Kansas. Agricultural Experiment Station. 9th Biennial Report, 1936-1938. The work of the biennium for the results are reported includes avian tuberculosis, a trichomonas parasite of poultry, selenium poisoning, anatomical studies of the respiratory tract of the chicken, and fowl paralysis, by L. D. Bushnell and M. J. Twiehaus; and parasites and resistance of chickens to parasitism, both by J. E. Ackert.

Ackerson, C. W. and Mussehl, F. E. Sex differences in the normal growth rate of chicks. Journal of Agricultural Research. v.40. p.863-866. May 1, 1930.

Baldwin, S. P. and Kendeigh, S. C. Physiology of the temperature of birds. Cleveland, Ohio. 1932. 196 p. Cleveland Museum of Natural History. Scientific Publications. v.3. Also, Baldwin Bird Research Laboratory. Contribution no.21.

Benedict, F. G., Landauer, Walter, and Fox, E. L. Physiology of normal and frizzle fowl, with special reference to the basal metabolism. New Haven, Conn., 1932. 101 p. Connecticut. Agricultural Experiment Station. Bulletin no.177.

Brody, Samuel and Campbell, John. Growth and development with special reference to domestic animals. XLVII. Relation between body weight, amount of wool on feathers, and temperature regulation. Columbia, Mo., 1938. 27 p. Missouri. Agricultural Experiment Station. Research Bulletin no.287.

Card, L. E. Body temperature of newly hatched chicks. Poultry Science. v.1. p.9-15. October-November 1921. This is the report of an experiment in which 119 Single Comb White Leghorn chicks were used at the New York Cornell Experiment Station to determine the temperature of chicks (male and female) on each of the first 5 days of hatching.

Conrad, R. M. Effect of high temperature on the blood calcium of the laying hen. Poultry Science. v.18. p.327-329. April 1939.

Fronda, F. M. Can the body temperature of a hen be used as a clue to her egg-laying capacity? Poultry Science. v.3. p.34-38. October-November 1923.

---. Comparative study of the body temperature of the different species and some representative breeds of poultry. A preliminary report. Poultry Science. v.1. p.16-22. October-November 1921.

---. Some observations on the body temperature of poultry. Cornell Veterinarian. v.15. p.8-20. January 1925.

Graham, J. D. P. Air stream in lung of the fowl. Journal of Physiology. v.97. p.133-137. December 1939. 1. A brief synopsis of the anatomy of the lungs of the bird and the controversy with regard to mechanism of respiration given. 2. Technique of study. 3. Results of analysis of contents of air sacs indicate the major proportion of gaseous interchange takes place during expiration.

Heywang, B. W. Effect of some factors on body temperature of hens. Poultry Science. v.17. p.317-323. July 1938. Body temperature lowest at midnight. Temperature highest during hottest part of day but were not lowest at coolest hour. Range 103.2° - 110.4° F.

Kaupp, B. F. Blood pressure and pulse of the fowl. Veterinary Medicine. v.18. p.919-922. October 1923. Investigations conducted at the North Carolina Experiment Station have shown the average blood pressure as taken from the femoral artery in 13 cocks to be 135 mm. The heartbeat of the fowl is shown to be so fast that the pulse can not be counted as in mammals.

Kaupp, B. F. Normal temperature of the adult domestic fowl. American Veterinary Medical Association. Journal. v.61. p.520-528. August 1922. Temperatures of these fowls were highest at night, gradually becoming lower after the fowl goes to perch, till at midnight all surplus heat from the body is apparently eliminated, and the average fell to 104.5° F.

_____ Respiration of fowls. Veterinary Medicine. v.18. p.36-40. January 1923. Report of studies at the North Carolina Experiment Station of the respiration of the hen, turkey, goose and duck.

_____ and Ivey, J. E. Time required for food to pass through the intestinal tract of fowls. Journal of Agricultural Research. v.23. p.721-725. March 3, 1923.
As a preliminary to study of digestive coefficients of poultry feeds, authors wished to run some tests to determine length of time required for feed to pass entire length of digestive tract. Length of small intestine in hen of average size is about 61.7 inches, and that of large intestine 4.61 inches, making total of 66.3 inches, which, added to length of second portion of esophagus, the proventriculous, and gizzard makes approximately 71.5 inches for food to pass.
Summary: Digestive processes of fowl are rapid. Greatest rapidity is shown in laying and growing fowl, passage of food requiring an average 3 hours and 52 minutes for growing fowls and 3 hours and 46 minutes for laying hens. Next in activity comes adult hen, not in laying condition, requiring 8 hours, and then broody hen, requiring average of 11 hours and 44 minutes.

Lamoreux, W. F. and Hutt, F. B. Variability of body temperature in the normal chick. Poultry Science. v.18. p.70-75. January 1939.

Michell, D. T. Causation and prevention of some diseases of donesticated birds in South Africa. Journal of Department of Agriculture of South Africa. v.10. p.504-522. June 1925.
Normal temperature of birds in South Africa ranges from 106.50° F. to 108° F., depending on whether the temperature is taken in the morning when a low temperature will be recorded or in the middle of the day or evening when a higher temperature will be found present. In cases of fever temperature may rise to 109° F or 111° F.

Mitchell, H. H. and Haines, W. T. Critical temperature of the chickens. Journal of Agricultural Research. v.34. p.549-557. March 15, 1927. Twelve Rhode Island Red hens ranging in weight from 4 to 6.1 lbs. were used in these experiments. The amount of carbon dioxide produced was measured in milligrams per minute at temperatures advancing 5° at a time from 45° to 85° F. By elimination it was found that these hens during fast in an atmosphere of low humidity and with winter feathering had a critical temperature of 62°.

Pembrey, M. S. and Gordon, M. H. and Warren, R. On the response of the chick before and after hatching to changes of external temperature. Journal of Physiology. v.17. p.331-348. 1894/1895. Respiratory exchange in eggs.

Wetmore, Alexander. Study of the body temperature of birds. Washington, D. C., 1921. 52 p. Smithsonian Institution. Miscellaneous collection. Publication no.2658. This is a detailed report of extended investigations conducted by the Biological Survey, U. S. Department of Agriculture. The author considers the method of securing avian body temperatures, diurnal rhythm in temperature, variation in temperature in relation to sex, external temperature in relation to bodily heat, diverse miscellaneous factors in their relation to body temperature, temperature of young, method of temperature control in birds, significance of temperature control, and discussion of differences in average temperatures. The data on which the discussion is largely based are presented in detail in tables covering 16 pages. A bibliography of 38 titles is included.

Winchester, C. F. and Kleiber, M. Effect of environmental temperature on mortality, rate of growth and utilization of food energy in white Leghorn chicks. Journal of Agricultural Research. v.57. p.529-544. October 1, 1938.

4. Disease Control and Prevention.

a. Sanitation and Disinfection.

Anonymous. Bacteriology and veterinary science. Relative efficiency of vermifuges for poultry. Fayetteville, Ark., 1934. p.33-34. Arkansas. Agricultural experiment station. Bulletin no.312. The work briefly referred to includes that to determine the efficiency of turpentine and oil, by W.L. Bleecker, and the efficiency of various vermifuges when tested under field conditions and control work with coccidiosis, both by W.L.Bleecker and R.M.Smith.

_____ Report of the conference of official research workers in animal diseases of North America on standard methods of pullorum disease in barnyard fowl, November 29, 1932. American Veterinary Medical Association. Journal. v.82. p.487-491. March 1933. This report deals with (1) the diagnosis of the disease in young chicks and (2) with serological diagnosis of pullorum disease (carrier condition) in maturing and in adult breeding stock.

Allen, P. W. and Jacob, M. Bacteriology. Knoxville, Tenn., 1937. p.25-26. Tennessee. Agricultural Experiment Station. Report, 1936. Brief reference is made to the progress of poultry yard sanitation investigation.

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Allen, E. A. Influence of diet on the development of experimental coccidiosis in chickens kept under sanitary conditions. American Journal of Hygiene. v.15. p.163-185. January 1932. This preliminary report of experiments aimed at the determination of the possible value of a well-balanced ration high in vitamins in enabling chickens to survive the most critical period of the caecal type of coccidiosis is presented in connection with a list of 13 references to the literature.

Bloecker, W. L. and Smith, R. M. Influence of vermifuge treatment of laying hens under field conditions. Poultry Science. v.14. p.313. September 1935.

Bunyea, Hubert. Two approved disinfectants for poultry feeding stations. U. S. Egg and Poultry Magazine. v.40. p.34-35, 55, 57. October 1934.

Bushnell, L. D., Payne, L. F., and Coon, C. J. Fumigation of forced-draft incubators. American Veterinary Medical Association. Journal. v.75. p.611-625. November 1929.

Cuvillier, E. and Jones, M. F. Comparative data relative to incidence of worm parasites in confined and non-confined chickens. Helmintholo-gical Society of Washington. Proceedings, 151st. Washington, D.C., 1932. p.252-256.

Emmel, M. W. Sulfured soil for poultry yards. American Veterinary Medical Association. Journal. v.94. p.409-410. April 1939. Findings in experiments on various uses of sulfur in connection with poultry raising, conducted during the past 3 years have shown sulfured soil to be of assistance in the control of diseases met with on premises in which birds must be confined in the same yards continuously. Pathogenic bacteria probably do not remain viable as long as the pH values of sulfured soil as in cases in which the soil is not so treated.

Feldman, W. H. Occurrence of avian tubercle bacilli in dressed poultry. Journal of Infectious Diseases. v.62. p.332-336. November-December 1938.

Graham, Robert and Brandly, C. A. Studies on incubator hygiene. -IX. The disinfecting properties of formaldehyde for hemophilic bacteria associated with avian coryza, the filtrable viruses of infectious laryngotracheitis, and infectious bronchitis. Poultry Science. v.16. p.428-433. November 1937.

_____, Thorp, Frank, Jr., and Torrey, J. P. Study of pullorum disease diabnostic tests. Poultry Science. v.12. p.112-119. March 1933.

Hall, G. O. Effects of controlled temperature and different light rays on breeding birds. Ithaca, N. Y., 1939. p.148-149. Cornell University. Agricultural Experiment Station. Annual Report, 1938.

Horton-Smith, C. and Taylor, E. L. Efficiency of the blowlamp for the destruction of coccidial oocysts in poultry-houses. Veterinary Record. v.51. p.839-842. July 8, 1939.

Hutt, F. B. and Bruckner, J. H. Genetic resistance to poultry diseases. Ithaca, N. Y., 1939. p.146. Cornell University. Agricultural Experiment Station. Annual Report, 1938. Susceptibility to high temperatures is independent of body size and of current and antecedent egg production.

Kaupp, B. F. and Surface, R. C. Poultry sanitation and disease control. Chicago, Ill., Kaupp and Surface, 1939. 420 p. This practical work, intended to be a complete guide to sanitation and treatment of diseases of poultry, is presented in 21 chapters.

McCulloch, E. C. Disinfection of poultry yards. Veterinary Medicine. v.31. p.386-389. September 1936. This discussion is presented with a list of 20 references.

Stafseth, H. J. and Camargo, Fernando. On the disinfection of poultry houses by means of "fire guns". American Veterinary Medical Association. Journal. v.86. p.162-166. February 1935.

Weaver, L. E. How to control coccidiosis. American Agriculturist. v.129. p.263, 273, 274. April 9, 1932.

b. Mortality.

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_____ Ohio conference on adult mortality among laying flocks of the Middle West. U. S. Egg and Poultry Magazine. v.43. p.275-276. May 1937.

Kennard, D. C. and Chamberlin, V. D. Livability of layers may be predetermined by management of the chicks. Wooster, O., 1938. p.17-23. Ohio. Agricultural Experiment Station. Bimonthly Bulletin, v.23, no.190.

Munro, S. S. Relation of production to mortality in the domestic fowl. Journal of Agricultural Science. v.26. p.101-113. January 1936. The Central Experimental Farm, Ottawa, has made a study of the relation between egg production and rate of mortality, as determined from 560 Leghorn and 710 Barred Rock hens entered in the Canadian egg-laying contest during a 51-week period. In both breeds studied the birds that died were on the average poorer layers than those that survived, with statistical evidence that the rate of production and rate of mortality are entirely independent. It is suggested that practices tending to increase production have in a measure also contributed toward health and lowered mortality.

c. Cannibalism and Its Control.

Kennard, D. C. Chicken vices. Wooster, O., 1937. p.33-39. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.184. The most common causes of feather picking and cannibalism are discussed, and effective prevention and control methods are suggested. The methods whereby the beak tip is removed with comparatively little discomfort to the bird and practically no loss of blood is described.

Miller, M. W. and Bearse, G. E. Cannibalism preventing properties of oats. Poultry Science. v.16. p.314-321. September 1937. The Western Washington Experiment Station reports the results of four feeding trials with growing and laying pullets, in one of which oats was compared with corn as the sole cereal in the ration. In two other trials oats, corn, and wheat were compared, and in the last trial oats, corn, wheat, and barley.

5. Incubation and Incubators.

Bradshaw, G. Artificial incubation. Agricultural gazette of New South Wales. v.20. p.126-134, 186-195, 301-306, 407-417. February, March, April, May, 1909. Early Egyptian and Chinese practice 500 years ago. History of methods and machines.

Byerly, T. C., Haynes, S. K., and Marsden, S. J. Incubation conditions and hatchability of turkey eggs. Poultry Science. v.17. p.253-256. May 1938.

_____ Resistance of chicken embryos to mechanical disturbances. Journal of Agricultural Research. v.56. p.221-226. February 1, 1938.

Carver, H. L. and Carver, J. S. Electric incubation and brooding. Pullman, Washington, 1929. 38 p. Washington. Agricultural Experiment Station. Bulletin no.231.

Graham, R. and Michael, V. M. Studies on incubator hygiene. III. Germicidal properties of formaldehyde, sulfur dioxide, chloropicrin, and chloracetophenone. Poultry Science. v.13. p.40-43. January 1934.

Jull, M. A. Studies in hatchability. V. The inheritance of hatchability. World's Poultry Congress, 4th. Conference Papers, section A. London, 1930. p.167-173.

Jull, M. A. Studies in hatchability. VI. Hatchability in relation to current egg production. Poultry Science. v.10. p.327-331. September 1931.

Penquite, Robert. Influence of temperature and humidity upon the growth of chick embryos in a mechanically ventilated incubator. Ames, Iowa, 1938. 39 p. Iowa. Agricultural Experiment Station. Research Bulletin no.232. Temperature of the incubator, humidity within the egg chamber, circulation of air around the egg, shell texture and the thickness and surface area of the egg shell. The type of incubator governs the temperature and humidity at which the machine should be operated.

Scott, H. M. Effect of age and holding temperatures on hatchability of turkey and chicken eggs. Poultry Science. v.12. p.49-54. January 1933. A series of experiments was undertaken at the Kansas Experiment Station to determine the effect of age at setting and the influence of the temperature during the holding period of fertile eggs of Bronze turkeys and White Leghorn chickens.

Walker, A. L. and Voss, G. E. Artificial incubation of hen eggs in New Mexico. State College, N. M., 1925. 21 p. New Mexico. Agricultural Experiment Station. Bulletin no.147.

a. Baby Chicks.

Olsen, M. W. and Byerly, T. C. Resistance of chicken embryos to mechanical disturbances. Journal of Agricultural Research. v.56. p.221-226. February 1, 1938. Careful handling from the fourth to the fifteenth day of incubation is recommended.

Romanoff, A. L., Bump, Gardiner and Holm, Earl. Artificial incubation of some upland game birds' eggs. Albany, N. Y., 1938. 44 p. New York. State Conservation Department. Bulletin no.2. These studies were conducted to determine the optimum environmental conditions applicable to the practical incubation of pheasant, grouse, and quail eggs and to establish recognizable symptoms by which the cause of unsuccessful hatches might be determined.

b. Temperature.

Barott, H. G. Effect of temperature, humidity, and other factors on hatch of hens' eggs and on energy metabolism of chick embryos. Washington, D. C., 1937. 45 p. U. S. Department of Agriculture. Technical Bulletin no.553.

Harman, M. T. Heat as a factor in producing abnormalities during incubation in the chick. Manhatten, Kansas, 1928. p.66-76. Kansas. Academy of Science. Transactions. v.31.

Henderson, E. W., and Brody, Samuel. Growth and development with special reference to domestic animals. V. Effect of temperature on the percentage rate of growth of the chick embryo. Columbia, Missouri, 1927. 11 p. Missouri. Agricultural Experiment Station. Research Bulletin no.99. Eggs were incubated at four different temperatures (94°, 95°, 99° and 105° F.) and the chick embryos weighed daily, beginning with the fourth day of incubation. The results of this work indicate that temperature exerts a profound influence on the percentage rate of growth and that this influence varies with the stage of incubation. These facts are expressed in quantitative forms by means of charts and equations, and their biological significance is discussed.

Nicholas, J. E. and Callebach, E. W. Thermal characteristics of electric brooders. Agricultural engineering. v.20. p.313-315. August 1939.

Penquite, Robert. Influence of temperature and humidity upon the growth of chick embryos in a mechanically ventilated incubator. Ames, Iowa, 1938. 39 p. Iowa. Agricultural Experiment Station. Research Bulletin no.232.

Pringle, E. M. and Barott, H. G. Effect of incubation temperature on time of death of chick embryo and relationship of energy metabolism to mortality. Journal of Agricultural Research. v.54. p.465-468. March 15, 1937.

Romanoff, A. L. Study of artificial incubation of game birds. Ithaca, N. Y., 1934. 39 p. Cornell University. Agricultural Experiment Station. Bulletin no.616. I. Temperature requirements for pheasant and quail eggs. II. Humidity requirements for pheasant and quail eggs.

c. Humidity.

Anonymous. Humidity in relation to hatchability of eggs. Moscow, Idaho, 1931. p.35-37. Idaho. Agricultural Experiment Station. Bulletin no.179. Using a cabinet type of incubator in which the air was kept in constant circulation produced better hatches in a series of 8 hatches when an average relative humidity of from 46 to 48 percent was used during the first 18 days of incubation, and an average of from 52 to 53 percent from the eighteenth day to the end of the hatching period.

Anonymous [Relative humidity in relation to hatchability of eggs.] Moscow, Idaho, 1930. p.24. Idaho. Agricultural Experiment Station. Bulletin no.170. To determine accurately the relative humidity in forced-draft incubators with a wet bulb hygrometer it was found necessary to maintain the following conditions: a long thin mercury bulb on the thermometer, (2) a constantly moistened wick, (3) a water reservoir in such a position that the wick is on a gradual incline from the water to the thermometer, and (4) not over 1 inch of exposed wick between the reservoir and the end of the thermometer.

Barott, H. G. Effect of temperature, humidity, and other factors on hatch of hens' eggs and on energy metabolism of chick embryos. Washington, D. C., 1937. 46 p. U. S. Department of Agriculture. Technical Bulletin no.553.

Cunningham, Bert. Effect of humidity on the developmental rate of chick embryos incubated under increased atmospheric pressure. Science. v.87. p.90-91. January 28, 1938. Eggs were incubated at a pressure of from 25 to 30 lb., under a reduced humidity so that the moisture lost from them during incubation was practically the same as in control eggs incubated at normal pressure and humidity. Both lots were incubated at 100° F. After 11 days' incubation the average weight of the embryos developed under pressure was 6.07 g. as compared with 3.69 g. for the controls, giving rather conclusive evidence that pressure was the primary factor responsible for the acceleration.

Mussehl, F. E. and Ackerson, C. W. Some observations on humidity and weight loss in the incubation of turkey eggs. Lincoln, Neb., 1934. 11 p. Nebraska. Agricultural Experiment Station. Research Bulletin no.74.

d. Ventilation.

Atwood, Horace and Weakley, C. E., Jr. Amount of carbon dioxide given off by eggs during incubation. Morgantown, W. Va., 1924. 15 p. West Virginia. Agricultural Experimental Station. Bulletin no.185.

Bailey, F. P. Method of measuring ventilation in incubators. Agricultural Engineering. v.8. p.247-248. September 1927. Sensitive balance, measures volume water in tank, displaces given volume by air.

Byerly, T. C. and Olsen, M. W. Influence of gravity and air-hunger on hatchability. Poultry Science. v.10. p.281-287. September 1931.

Chattock, A. P. On the physics of incubation. Royal Society of London. Philosophical Transactions. Series B. v.213, no.B,409. p. 397-450. 1925. This is a study of the effect of turning and cooling, humidity and ventilation, and loss of weight of eggs during artificial and natural incubation on the percentage hatchability.

6. Brooders.

Callenbach, E. W., Nicholas, J. E., and Margolf, P. H. Poultry brooding systems. State College, Pa., 1937. 40 p. Pennsylvania. Agricultural Experiment Station. Bulletin no.340.

Humphrey, J. E. and Kelley, J. B. Brooding chicks artificially. Lexington, Ky., 1940. 35 p. Kentucky. Agricultural Experiment Station. Circular no.157.

Johnson, G. I. Brick brooders. Experiment, Ga., 1935. 4 p. Georgia. Agricultural Experiment Station. Circular no.167.

Jones, R. E. Connecticut 12 x 12 colony brooder house. Storrs, Conn., 1940. 12 p. Connecticut. State College. Extension Service. Bulletin no.290.

Mallman, W. L., Moore, J. M., and Arnold, L. R. Study of pullorum disease in baby chicks as shown by the effect of different temperatures in brooding. Poultry Science. v.12. p.323. September 1933.

Rowlands, M. J. Scientific and modern chick rearing and battery brooding. London, Poultry World, ltd., 1932. 172 p. This treatise, based on the experience of the author and on the practical knowledge of poultry farmers, is designed as a handbook on chicken rearing and battery brooding. Information is given on the process of digestion, foods and their functions, management of battery brooders, coccidiosis and other diseases to which chickens are prone, and the prevention or cure of these diseases.

Shafer, A. E. Brooder house with circular roof. Farm Journal. v.57. p.11. December 1933.

Swink, E. T. Tests of chick brooders. Blacksburg, Va., 1936. 16 p. Virginia. Agricultural Experiment Station. Bulletin no.306. This bulletin reports the results of a series of tests on several types of brooders. The object was to determine (1) the fuel consumption of each type of brooder as a basis of comparing operating costs, (2) the comparative brooding results obtained, and (3) the most practical type of electric brooder for use on Virginia farms. Six brooder houses approximately 9 by 12 ft. in dimensions were used. They were not insulated, had single thickness tongue and grooved floors, and their design was similar to the standard V.P.I. portable colony houses. The same principle of ventilation was used in all houses, and a uniform exposure was obtained. The following brooders were selected: (1) Standard 56-in. electric with natural ventilation, (2) standard 56-in. electric with forced ventilation unit, (3) home-made electric using a 52-in. metal hover from a discarded fuel-type brooder, (4) home-made electric 72 by 30 by 9.5 in. constructed of wood, (5) commercial coal brooder, (6) commercial kerosene brooder, and (7) commercial wood stove. All electric brooders used in the test had "black heat" or low temperature heating elements.

a. Heaters.

Davidson, J. A. and Gallagher, H. J. Comparison of electric and coal brooders in early season brooding. East Lansing, Mich., 1935. p.97-105. Michigan. Agricultural Experiment Station. Quarterly Bulletin, v.18, no.2. Results of two tests showed that the rate of feathering of broilers was slower under electric hovers than under coal hovers. With the type of ventilation used, insulation was not justified from the standpoint of fuel consumption. A fan or air agitator on one of the electric hovers did not materially increase the amount of power used, but was helpful in the early brooding period when the hover was down.

Mallmann, W. L. Effects of different brooding temperatures on pullorum disease. Veterinary Medicine. v.29. p.254-255. June 1934. The information obtained is considered to emphasize the extent to which unfavorable conditions lower the vitality of chicks and render them more susceptible to pullorum disease.

Tepper, A. E., Stuart, H. C., and Charles, T. B. [Poultry experiments.] Durham, N. H., 1932. p.24-25. New Hampshire. Agricultural Experiment Station. Bulletin no.262. This report includes further studies on measuring vitamin A requirements of chicks, a comparison of brooder temperatures, and added protein in raising gains of chicks.

Weaver, D. S. and Parrish, C. F. Homemade brick brooder. West Raleigh, N. C., 1932. 2 p. mimeographed. North Carolina. College of Agriculture and Mechanic Arts. Agriculture Extension Service. Information Agronomy Circular no.76.

b. Electric Brooders.

Ackerman, W. T. and others. - I. Electric brooding of chicks. Durham, N. H., 1934. 16 p. New Hampshire. Agricultural Experiment Station. Circular no.46.

_____ Electric brooding of chicks. - II, Heat requirements. Durham, N. H., 1938. 31 p. New Hampshire. Agricultural Experiment Station. Bulletin no.303.

Dougherty, J. E. Advantages and disadvantages of electric brooders. Agricultural Engineering. v.12. p.157-160. May 1931. In a contribution from the California Experiment Station, the problems relating to electric brooding are analyzed, with particular reference to design, construction, and operation.

Price, F. E., Lunn, A. G., and Fox, F. E. Electric brooders. Corvallis, Ore., 1930. 24 p. Oregon. Agricultural Experiment Station. Bulletin no.262. This bulletin, prepared in cooperation with the Oregon Committee on Electricity in Agriculture, presents the results of experimental work with electric brooders to determine power requirement, rate of growth, quality of the chick, mortality, and convenience and dependability in the operation of various types of electric brooders. Electric brooders should have sufficient heating capacity to maintain a temperature of 100° F. with no chicks under the hover during the coldest brooding weather.

Scott, J. C. Modern methods in electric brooding. Rural Electrification Exchange. n.s., v.1. p.1-4. January 1938.

7. Egg Production.

Atwood, H. Certain correlations in the weight and number of eggs and the weight of fowls. Morgantown, W. Va., 1923. 16 p. West Virginia. Agricultural Experiment Station. Bulletin no.182.

Dunn, L. C. Statistical study of egg production in four breeds of the domestic fowl. Part IV.- White Leghorns. Storrs, Conn., 1927. 241-282p. Storrs. Agricultural Experiment Station. Bulletin no.147. Few birds laid less than 75 or more than 240 eggs per year, the average yearly egg production for the nine years being 158.

Kennard, D. C. and Chamberlin, V. D. Egg production and livability of pullets as affected by management. Poultry Science. v.18. p.318-322. July 1939. Comparison of range, wire sun porch and battery raised pullets. High temperatures have a marked effect on the blood calcium of a laying hen, an increase of temperature from 70° to 90° F. caused a decrease of 25 to 30 percent in the blood calcium level.

Knox, C. W. Factors influencing egg production. Ames, Iowa, 1932. 249-260 p. Iowa. Agricultural Experiment Station. Research Bulletin no.152. Association of date of hatch with first egg, sexual maturity, and egg production in S. C. White Leghorns.

Lerner, I. M. and Taylor, L. W. Interrelationships of egg production factors as determined for white leghorn pullets. Journal of Agricultural Research. v.55. p.703-712. November 1, 1937.

Lerner, I. M. and Taylor, L.W. Relation of pauses to rate of egg production. Journal of Agricultural Research. v.52. p.39-47. January 1, 1936. At the California Experiment Station, a study was made with a selected population of 578 White Leghorns in their pullet year to determine whether or not pausing bears any relation to the rate of production and to evaluate the accuracy of some methods for its calculation. Three series of birds, hatched in three consecutive years, were represented in the total population, and each series was treated separately. The analyses showed that the condition of winter pause was causally distinct from that of spring pause and was entirely separate from it.

Moore, J. M., Pfahler, E. H. and Card, C. G. Hens v. pullets. East Lansing, Mich., 1935. p.197-202. Michigan. Agricultural Experiment Station. Quarterly Bulletin no.17. Pullet production was higher in the fall and lower in the winter than hen production.

Romanoff, A. L. and Romanoff, A. J. Biochemistry and biophysics of the developing hen's egg. II. Influence of composition of air. Ithaca, N. Y., 1933. 36 p. Cornell University. Agricultural Experiment Station. Memoir no.150.

Thompson, W. C. Egg farming. N. Y., Orange Judd Publishing Co., 1936. 335 p. Discusses maintaining the health and productivity of well-bred laying stock; methods and practices of chick production and rearing on the egg farm; the economical and efficient housing of young and adult poultry.

Waite, R. H. Poultry experiments, observations, notes and plans. College Park, Md., 1921. 40 p. Maryland. Agricultural Experiment Station. Bulletin no.244.

a. Fertility.

Brody, S., Funk, E. M. and Kempster, H. L. Growth and development, with special reference to domestic animals.- XLIV. Energetic efficiency of egg production and the influence of live weight thereon. Columbia, Mo., 1938. 59 p. Missouri. Agricultural Experiment Station. Research Bulletin no.278.

Funk, E. M. and Kempster, H. L. Egg weight in the domestic fowl. Columbia, Mo., 1934. 15 p. Missouri. Agricultural Experiment Station. Bulletin no.332.

_____ Relation of sexual maturity and egg weight in the domestic fowl. Journal of Agricultural Research v.49. p.1033-1039. December 1, 1934.

Parkhurst, R. T. Some factors affecting egg weight in the domestic fowl. Poultry Science. v.12. p.97-111. March 1933.

Payne, L. F. and Hughes, J. S. Effect of inadequate rations on the production and hatchability of eggs. Manhattan, Kan., 1933. 64 p. Kansas. Agricultural Experiment Station. Technical Bulletin no.34.

b. Storage.

Anonymous. Eggs and egg products. Washington, D. C., 1941. 91 p. U. S. Department of Agriculture. Circular no.583.

Barmore, M. A. Recent developments in the chemistry of storage and preparation of foods. Food Research. v.1. p.383-398. September-October, 1936. Storage of eggs.

Bryant, R. L. and Sharp, P. F. Effect of washing on the keeping quality of hens' eggs. Journal of Agricultural Research. v.48. p.67-89. January 1, 1934.

Heitz, T. W. Art of storing eggs and poultry. U. S. Egg and Poultry Magazine. v.36. p.38-41, 56, 58. February 1930.

Kennard, D. C. and Chamberlin, V. D. Market egg grades as affected by humidity of farm egg storage rooms. Wooster, Ohio, 1939. p.126-130. Ohio. Agricultural Experiment Station. Binonthly Bulletin. v.24, no.199. Increased profits; Relative humidity should be about 70% at 50° to 60° F. and 80% at 60° to 70° F.

McCarmon, R. B., Pittman, M. S. and Wilhelm, L. A. Odor and flavor of eggs. Poultry Science. v.13. p.95-101. March 1934. Studies at the Kansas Experiment Station indicated that the yolk color of eggs was affected by the ration fed, becoming deeper with the addition of yellow corn or green wheat. More variations were noted for odor than for flavor, and the former was always less desirable than the latter. The odor was apparently influenced by both the ration and method of handling. Strong odors due to method of handling disappeared on holding.

Montfort, P. T. Use of mechanical refrigeration for farm egg storage. Agricultural Engineering. v.12. p.439-441. December 1931.

Nicholas, J. E. Precooling eggs on the farm. Refrigerating Engineering. v.32. p.213-215. October 1936.

Price, F. E. How to construct an insulated egg storage room. Corvallis, Ore., 1932. 11 p. Oregon. State College. Extension Service. Bulletin no.445.

Reder, R. Egg composition. I. The effect of diet and storage on the chemical composition of eggs. Poultry Science. v.18. p.19-25. January 1939.

Sharp, P. F., Stewart, G. F. and Huttar, J. C. Effect of packing materials on the flavor of storage eggs. Ithaca, N. Y., 1936. 26 p. Cornell University. Agricultural Experiment Station. Memoirs no.189.

_____ Effect of relative humidity on the growth of mold on eggs in storage. Ithaca, N. Y., 1936. 11 p. Cornell University. Agricultural Experiment Station. Memoirs no.191.

Slocum, R. R. Methods of packing eggs and of buffing and bracing cases of eggs in carload shipments. Washington, D. C., 1926. 15 p. U. S. Department of Agriculture. Department Circular no.391.

_____ and others. Study of egg flavor in stored oil-treated eggs. U. S. Egg and Poultry Magazine. v.39. p.14-17, 47. April 1933.

Smith, R. M. Influence of some factors on the storage quality of eggs. Fayetteville, Ark., 1937. 33 p. Arkansas. Agricultural Experiment Station. Bulletin no.341.

_____ [Livestock investigations in Arkansas.] Fayetteville, Ark., 1936. p.37-40. Arkansas. Agricultural Experiment Station. Bulletin no.337. Factors affecting the storage quality of eggs, and rice by-products in the laying ration.

Swenson, T. L. Storage of shell eggs. Food Research. v.3. p.599-608. November-December 1938.

Toop, E. Occurrence of mold on egg containers in storage at a Chicago plant. U. S. Egg and Poultry Magazine. v.45. p.397-399, 448. July 1939.

Upp, C. W. Will Louisiana eggs keep? Baton Rouge, La., 1934. 8 p. Louisiana. Agricultural Experiment Station. Circular no.13.

Valenzuela, A. and Rotea, S. Y. Further studies on the preservation of eggs. Philippine Journal of Animal Industry. v.3. p.211-220. 1936.

c. Quality.

Alph, H. H., Ashby, R. C., and Card, L. E. Studies of market quality of eggs from 109 farms in southeastern Illinois. Urbana, Ill., 1938. 399-411 p. Illinois. Agricultural Experiment Station. Bulletin no.441.

Burmester, B. R. and Card, L. E. On the nature of "meat spots" in eggs. Poultry Science. v.17. p.235-239. May 1938.

Funk, E. M. Factors influencing production of clean eggs. Columbia, Mo., 1937. 12 p. Missouri. Agricultural Experiment Station. Bulletin no.384. Information is based on observations extending over 15 months and including the classification of over 66,000 eggs with respect to cleanliness. Most of the soiling of eggs occurred in the nest, since more than 99 percent of all eggs were clean before they came in contact with the nest. When open nests were used, darkening the nests materially decreased the percentage of dirty eggs. A higher percentage of clean eggs was gathered from trap nests than from open nests and from birds confined to laying houses than from those on range. Shavings, oat hulls, sawdust, and excelsior were the most effective nesting materials for preventing dirty eggs.

_____ Improving the keeping quality of eggs by cleaning with sodium hydroxide. Columbia, Mo., 1938. 40 p. Missouri. Agricultural Experiment Station. Research Bulletin no.277.

Marshall, W. and Cruickshank, D. B. Function of the cuticle in relation to the porosity of eggs. Journal of Agricultural Science. v.28. p.24-42. January, 1938.

Perry, F. D. Influence of rations and storage on the physical characteristics of eggs. Ames, Ia., 1936. 32 p. Iowa. Agricultural Experiment Station. Research Bulletin no.192. It was found that the level of protein supplement apparently did not influence the loss of weight of eggs during storage.

8. Broilers.

a. Management.

Callenbach, E. W. and Nicholas, J. E. Effect of rearing environment on sexual development of fowls. State College, Pa., 1938. 9 p. Pennsylvania. Agricultural Experiment Station. Bulletin no.368.

Winchester, C. F. and Kleiber, M. Effect of environmental temperature on mortality, rate of growth, and utilization of food energy in white leghorn chicks. Journal of Agricultural Research. v.57. p.529-544. October 1, 1938.

9. Environment.

Barott, H. A. Effect of temperature, humidity and other factors on hatch of hen's eggs and on energy metabolism of chick embryos. Washington, D. C., 1937. 45 p. U. S. Department of Agriculture. Technical Bulletin no.553.

Brody, Samuel. Factors influencing the apparent energetic efficiency of productive processes in farm animals. Journal of Nutrition. v.17. p.235-251. March, 1939. Egg production and growth.

Callenbach, E. W. and Nicholas, J. E. Effect of rearing environment on the sexual development of fowls. State College, Pa., 1938. 9 p. Pennsylvania. Agricultural Experiment Station. Bulletin no.368.

Cunningham, Bert. Apparatus for studying the effect of increased atmospheric pressure upon the developing hen egg. Science. v.80. p.99-100. July 27, 1934.

Romanoff, A. L. Fertilized bird's egg as a physicochemical system. Poultry Science. v.13. p.283-285. September, 1934.

Van Es, L. and Olney, J. F. Inquiry into the influence of environment on the incidence of poultry diseases. Lincoln, Neb., 1940. 57 p. Nebraska. Agricultural Experiment Station. Bulletin no.118.

Winchester, C. F. and Kleiber, M. Effect of environmental temperature on mortality, rate of growth, and utilization of food energy in white leghorn chicks. Journal of Agricultural Research. v.57. p.529-544. October 1, 1938.

a. Temperature.

Bennion, N. L. and Warren, D. C. Temperature and its effect on egg size in the domestic fowl. Poultry Science. v.12. p.69-82. March 1933. Birds were more sensitive to sudden changes in temperature than to gradual changes, but extremes of temperatures in either direction were followed by a decline in production.

Botsford, H. E. Effect of comb frosting on egg production. American Poultry Journal. v.60. p.120-121. February 1929. Production is not always affected by cool weather.

Burrows, W. H. and Byerly, T. C. Effect of certain groups of environmental factors upon the expression of broodiness. Poultry Science. v.17. p.324-330. July 1938. Moderate temperatures, slow temperature changes, light, and removal of eggs inhibited the development of broodiness.

Henderson, E. W. Growth and development with special reference to domestic animals. XVI. The influence of temperature and breeding upon the rate of growth of chick embryos. Columbia, Mo., 1930. 47 p. Missouri. Agricultural Experiment Station. Research Bulletin no.149.

Heywang, B. W. Effect of some factors on the body temperature of hens. Poultry Science. v.17. p.317-323. July 1938.

Romanoff, A. L., Smith, L. L. and Sullivan, R. A. Biochemistry and biophysics of the developing hen's eggs. III. Influence of temperature. Ithaca, N. Y., 1938. 42 p. Cornell University. Agricultural Experiment Station. Memoirs no.216.

Romanoff, A. L. Effects of different temperatures in the incubator on the prenatal and postnatal development of the chick. Poultry Science. v.15. p.311-315. July 1936. Data are reported on the hatchability, incubation period, weight of eggs, mortality of brooded birds, crippled chicks, and weight at 3 weeks of age as influenced by different incubation temperatures ranging from 35° to 40.5° C. and from 29.5° to 41.5° after 16 days in studies at the (New York) Cornell Experiment Station.

Smith, C. W. Relation of environmental conditions in poultry houses to winter egg production. Lincoln, Neb., 1930. 34 p. Nebraska. Agricultural Experiment Station. Bulletin no.247.

Winchester, C. F. and Kleiber, M. Effect of environmental temperature on mortality, rate of growth, and utilization of food energy in White leghorn chicks. Journal of Agricultural Research. v.57. p.529-544. October 1, 1938.

b. Humidity.

Kennard, D. C. and Chamberlin, V. D. Eight years' experience with losses of pullet layers. Wooster, O., 1936. p.63-69. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.180.

c. Seasonal.

Bobby, F. C. Influence of winter confinement of White leghorn pullets on winter egg production. Harper Adams Utility Poultry Journal. v.12. p.432-435. 1926/27.

Bruckner, J. H. Effect of environmental conditions on winter egg production. Poultry Science. v.15. p.417-418. September 1936. Abstract.

Coles, R. Egg quality: The influence of climate and soil. Journal of the Ministry of Agriculture. v.43. p.317-332. July 1936. Based on a study of the quality of eggs received at the central markets of England, the author shows that definite differences exist between different sections. Areas having a low relative humidity yield eggs having dense shells of low permeability and resistant to evaporation, while eggs from areas having high relative humidity have more porous shells which tend to deteriorate more rapidly, particularly when held in market centers having a low humidity.

Hays, F. A. Hatchability as related to seasons and hour of laying. Poultry Science. v.16. p.85-89. March 1937.

Helmer, R. H. [Investigations with poultry at the Summerland Experimental Station.] Summerland, B. C., 1922. p.85-90. Canada. Experimental Farms. Report, 1922. Egg production -- Hens v. pullets by months. Effect of winter production upon fertility and hatchability.

Hervey, G. W. Prediction of egg records. New Brunswick, N. J., 1923. 20 p. New Jersey. Agricultural Experiment Station. Bulletin no.389.

Jeffrey, F. P. Out-of-season brooding. American Poultry Journal (central edition). v.71. p.3 + May 1940. Year round hatching.

Jull, M. A. Early laying: Its econimic significance. Agricultural Gazette of Canada. v.10. p.244-248. May 1923.

_____ Relative value of the monthly distribution of egg production. Scientific Agriculture. v.3. p.276-284. April 1923.

Kempster, H. L. Influence of summer temperatures on the rate of growth of chickens. Poultry Science. v.17. p.259-263. July 1938. Earlier hatched birds grew at a more rapid rate than later hatched birds during the first 20 weeks.

Smith, C. W. Relation of environmental conditions in poultry houses to winter egg production. Lincoln, Nebraska, 1930. 34 p. Nebraska. Agricultural Experiment Station. Bulletin no.247.

Whetham, E. O. Factors modifying egg production with special reference to seasonal changes. Journal of Agricultural Science. v.23. p.383-419. July 1933.

10. Light.

a. Natural.

Anonymous. Poultry nutrition. Ithaca, N. Y., 1930. p.88-89. Cornell University. Agricultural Experiment Station. Report, 1930. Part 2. In a study of the seasonal variation of sunshine it was found that the antirachitic value of early summer noontime sunlight was about twice that of early winter noontime sunlight. Exposures of 5, 10, and 40 minutes, respectively, to these sunlights prevented the development of rickets in chicks and produced normal growth up to 12 days of age. Glazing materials which, after solarization, permitted transmission of 25 percent of the available ultraviolet rays of sunlight at 302μ were satisfactory for exposing chicks to spring and summer sunlight, but were of doubtful value during the winter, due to the long exposure required.

Bethke, R. M. and Kennard, D. C. Growth of chicks as affected by sunlight thru window glass, thru a glass substitute, and direct sunlight. Wooster, Ohio, 1926. p.131-135. Ohio. Agricultural Experiment Station. Bimonthly Bulletin. v.11, no.4. Chicks receiving direct sunlight or sunlight through the celoglass made normal growth throughout the 10 weeks of the experiment, but severe leg weakness developed at the fifth week in the lot having access only to sunlight through the window glass.

Bissonnette, T. H. Light or exercise as factors in sexual periodicity in birds? Science. v.76. p.253-255. September 16, 1932. Discusses the part played by exercise and light on sexual activity in birds and rats, and concludes that it is the radiation changes which bring about development of the sex glands which, in turn, influence voluntary exercise.

Charles, T. B. and Knandel, H. C. Rearing chicks in confinement. College Station, Pa., 1928. 12 p. Pennsylvania. Agricultural Experiment Station. Bulletin no.218.

Fronda, F. M. and Belo, J. A. Effects of sunlight on the hatching quality of eggs. Philippine Agriculturist. v.16. p.477-493. January 1928. Experiments were conducted at the University of the Philippines to determine the effect of exposure to the sun on hatchability of egg and how much exposure would produce the best results.

Hart, E. B., Steenbock, H., and Lepkovsky, S. Nutritional requirements of baby chicks. III. The relation of light to the growth of chicken. Journal of Biological Chemistry. v.58. p.33-41. November 1923. One lot received no direct sunlight, one lot received sunlight all day, other lots received 10 minutes and 1 hour of sunlight, respectively, and the fifth lot was radiated 10 minutes daily with a quartz mercury vapor lamp.

_____ and others. Nutritional requirement of the chicken. V. The influence of ultra-violet light on the production, hatchability, and fertility of the egg. Journal of Biological Chemistry. v.65. p.579-595. October 1925.

Houser, G. F. and Norris, L. C. Rickets in chicks. III. The effectiveness of mid-summer sunshine and irradiation from a quartz mercury vapor arc in preventing rickets in chicks. Poultry Science. v.8. p.89-98. January 1929.

Hughes, J. S. and Payne, L. F. Influence of ultra-violet light on young laying hens. Science. v.60. p.549-550. December 12, 1924.

Kennard, D. C. Housing conditions for chickens in confinement. Wooster, Ohio, 1932. p.111-116. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.156. Practical information is given on the housing of chickens in confinement, with particular reference to the admission of natural daylight.

Mayerson, H. S. and Laurens, H. Efficiency of New Orleans sunshine in preventing leg weakness and promoting growth in chicks. Poultry Science. v.11. p.325-334. November 1932.
A study was undertaken with 2-day-old chicks to determine whether the antirachitic wave lengths of sunlight would be absorbed or diminished in their passage through the atmosphere at the low elevation and under the semitropical conditions of New Orleans. In addition to exposing chicks to direct sunshine and skyshine (reflected radiation from sky and clouds), other groups were kept under Vitaglass, Corex D, and Cel-O-Glass. Each test was conducted for 6 weeks, and the chicks were weighed weekly. At 8 weeks of age the chicks were X-rayed, killed, and the blood pooled for the determination of serum calcium and phosphorus.

Mitchell, H. H. and Card, L. E. Properly fed chickens thrive in darkness. Urbana, Ill., 1925. p.83-85. Illinois. Agricultural Experiment Station. Annual Report, 1924. Eight lots of 10 White Leghorn chicks each were selected for studying the effect of sunlight and concentrated ultraviolet light on the growth of chickens receiving complete diets and diets lacking in vitamin A.

Russell, W. C. and Massengale, O. N. Effect on bone formation of winter sunlight transmitted by a glass substitute. Poultry Science. v.7. p.85-91. January 1928.

Scott, H. T., Hart, E. B. and Halpin, J. G. Winter sunlight, ultra-violet light, and glass substitutes in the prevention of rickets in growing chicks. Poultry Science. v.9. p.65-76. November 1929.

Wheeler, W. P. Limitations as to sunlight requirements of hens. Geneva, N. Y., 1929. 14 p. New York. Agricultural Experiment Station. Bulletin no.572.

Wood, W. F., Jr. Comparison of the growth of chicks behind window glass and a glass substitute. Poultry Science. v.6. p.62-70. December-January, 1926-1927.

b. Artificial.

Anonymous. Artificial lighting. (Experiments with poultry at the South Dakota Station). Brookings, S. D., 1928. p.26. South Dakota. Agricultural Experiment Station. Report, 1928.
Pullets in lighted pens had a production percentage of 49 as compared with 30 for pullets in unlighted pens. While consumption of mash was higher in the lighted pens, the cost of feed per dozen eggs was lower than in unlighted pens. The lights had no apparent ill effects on pullets as breeders or layers in later years.

Electrified chickens -- Electricity as a growth stimulator. Scientific American Supplement. v.77. p.63. January 24, 1914.

Banta, Luther. Artificial lighting for poultry. Amherst, Mass., 1932. 8 p. Massachusetts. State College. Extension Service. Extension Leaflet no.141.

Bice, C. M. and Tower, B. A. Relationship of artificial illumination to pullet raising in Hawaii, with special reference to partial molt and egg production. Washington, D. C., 1937. 7 p. Hawaii. Agricultural Experiment Station. Circular no.12.

Bissonnette, T. H. Does increased light absorption cause increased egg production in the fowl? Poultry Science. v.12. p.396-399. November 1933.

Byerly, T. C. and others. Effects of light, soybean, and other diet supplements on seasonal hatchability and egg production. Poultry Science. v.16. p.322-330. September 1937.

Clark, L. B., Leonard, S. L. and Bump, G. Light and sexual cycle of game birds. Science. v.85. p.339-340. April 2, 1937.

Dakan, E. L. Poultry house lighting and its influence on egg production and chicken growth. Rural Electrification Exchange. n.s., v.1. p.13-15. January 1938.

Donahue, D. D. Effect of radiation on the resistance of chickens to fowl cholera. American Journal of Hygiene. v.15. p.206-231. January 1932. In the studies here reported over 500 chickens were exposed to various sources of radiation and then infected with Pasteurella avicida, using subcutaneous or intranasal inoculation.

Fairbanks, F. L. Artificial illumination of poultry houses for winter egg production. Ithaca, N. Y., 1924. 28 p. Cornell University. Extension Service. Bulletin no.90.

Hendricks, W. A. and others. Effects of cod-liver oil and ultra-violet irradiation, as influenced by oyster shell, in the diet of confined laying hens. Journal of Agricultural Research. v.43. p.517-535. September 15, 1931.

Kable, G. W. Carbon arc lamps for lighting and irradiating of laying pullets. Agricultural Engineering. v.9. p.191. June 1928.

_____, Fox, F. E., and Lunn, A. G. Electric lights for increasing egg production. Corvallis, Ore., 1928. 37 p. Oregon. Agricultural Experiment Station. Bulletin no.231.

Kaupp, B. F. Lights vs. no lights. (Poultry experiments at the North Carolina Station). Raleigh, N. C., 1924. p.65. North Carolina. Agricultural Experiment Station. Report, 1924. Annual egg production of pullets was increased 50 percent by furnishing electric lights from November 1 to April 1, making 14 feeding hours daily.

Kennard, D. C., and Chamberlin, V. D. All-night light for layers. Wooster, Ohio, 1931. 22 p. Ohio. Agricultural Experiment Station. Bulletin no.476.

---. All-night lights for winter layers. Wooster, Ohio, 1929. p.195-198. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.141. In a demonstration of all-night lights for layers, 3 groups of 40 Leghorn pullets each were started on December 1. The groups averaged 19 percent egg production when the lights were turned on, 30 percent 2 weeks later, and 57 percent after 4 weeks of lighting. These birds laid 49 eggs each to March 1, and the mortality to June 15 was 12.5 percent. Another lot with a 40 percent production before being lighted increased to 65 percent in 2 weeks and to 75 percent in 4 weeks. The pullets in this lot laid 57 eggs each from December 1 to March 1, with a mortality of 12.5 percent.

Murray, J. M. and Little, C. C. Influence of ultra-violet light on nutrition in poultry. Orono, Maine, 1934. .141-164 p. Maine. Agricultural Experiment Station. Bulletin no.320.

Nestler, R. B. Comparative value of cod-liver oil alone and in combination with irradiated ergosterol as a source of vitamin D for confined laying hens. Journal of Agricultural Research. v.56. p.209-219. February 1, 1938.

Penquite, Robert and Thompson, R. B. Influence of continuous light on Leghorns Poultry Science. v.12. p.201-205. May 1933.

---. Results of a 10 year study of the influence of artificial light on egg production. Poultry Science. v.19. p.358. September, 1933.

Platt, C. S. Use of artificial light for poultry. New Brunswick, N. J., 1937. 4 p. New Jersey. Agricultural Experiment Station. Hints to Poultrymen. v.24. Stimulating effect of light on egg production is discussed, and suggestions are offered as to when to use artificial light and how to feed the flock receiving it.

Reid, K. M. Application of ultra-violet radiation in the poultry industry. Agricultural Engineering. v.14. p.13-14. January 1933. This abstract reviews studies at different institutions on the effect of ultra-violet radiation of poultry, indicating its utility in increasing egg production and fertility and in hastening the growth of chicks.

Scott, H. M. and Payne, L. F. Light in relation to the experimental modification of the breeding season of turkeys. Poultry Science v.16. p.90-96. March 1937.

Suomalainen, H. Effect of temperature on the sexual activity of non-migratory birds, stimulated by artificial lighting. Ornis Fennica. v.14. p.108-112. 1937.

Warren, D. C. and Scott, H. M. Influence of light on ovulation in the fowl. Journal of Experimental Zoology. v.74. p.137-156. August, 1936.

Wilcke, H. L. Use of artificial lights for turkeys. Poultry Science. v.18. p.236-243. May 1939. Experiments extending over four seasons gave evidence that turkey females may be brought into earlier egg production by the use of artificial lights either in the morning and evening or all night. It required approximately 6 weeks for turkeys to reach a reasonably high level of production after the lights were turned on. The total number of eggs per bird to the end of June was increased by artificial lighting, while egg weight was not affected. Neither lighting nor heating had any significant influence on fertility or hatchability of the eggs. Total feed consumption was not affected by the use of either heat or light, but heating resulted in a much higher consumption of mash in proportion to grain as compared with the unheated groups.

11. Air Conditioning.

Anonymous. (Agricultural engineering investigations by the Cornell Station). Ithaca, N. Y., 1937. p.94-97. Cornell University. Agricultural Experiment Station. Report, 1937. A brief historical review is presented of investigations on spraying equipment, dairy and poultry structure illumination and ventilation, and related subjects.

_____ Air requirements for poultry. Ames, Ia., 1928. p.26. Iowa. Agricultural Experiment Station. Annual Report, 1928.

_____ Air requirements for poultry. Ames, Ia., 1929. p.26. Iowa. Agricultural Experiment Station. Annual Report, 1929.

_____ Air requirements of poultry. Ames, Ia., 1938. p.97. Iowa. Agricultural Experiment Station. Annual Report, 1938.

_____ Poultry house cooling. Berkeley, Cal., 1939. p.94. California. Agricultural Experiment Station. Report, 1937-1938.

Barott, H. G. Poultry research aided by air conditioning. Heating and Ventilating. v.36. p.23-25. September 1939. Description of nutrition laboratory at Beltsville, Md.

Emmel, M. W. Fowl leukemia induced by adverse atmospheric conditions. American Veterinary Medical Association. Journal. v.93. p.387-388. December 1938.

Hart, T. H. Air conditioning and the humble hen egg. Aerologist. v.8. p.17-19. October 1932. Air conditioning nature chickens. Chicken comfort zone.

Miller, M. W., Bearse, G. E. and Cushing, G. Factors effecting wet litter. Poultry Science. v.12. p.173-178. May 1933.
Western Washington Experiment Station undertook a study of the effects of floor heat and ventilation on the maintenance of dry litter in poultry houses.

Mitchell, H. H. and Kelley, M. A. R. Estimated data on the energy, gaseous, and water metabolism of poultry for use in planning the ventilation of poultry houses. Journal of Agricultural Research. v.47. p.735-748. November 15, 1933.

Nicholas, J. E. and Callenbach, E. W. Air conditioned poultry brooder houses. Agricultural Engineering. v.17. p.518-521. December 1936.

Pennington, M. E. Effect of ventilation on the keeping quality of eggs in cold storage. Canton, Pa., 1923. p.5-13.
Marble Laboratory, Inc. Storage Investigations, 1921-1922.

a. Physics of Air.

Richardson, H. L. Ventilation of brooder houses. Newark, Del., 1940. 4 p. Delaware. College. Division of Agricultural Extension. Circular no.39.

Romanoff, A. I. Effect of composition of air on the growth and mortality of the chick embryo. Journal of Morphology and Physiology. v.50. p.517-525. December 5, 1930.

Stiles, G. W., Jr. Carbon monoxide poisoning in chickens. Poultry Science. v.15. p.270-272. May 1936.

Trillat, A. Experience d'infection par voie aerienne. Cas du cholera des poules. Paris. Academie des Sciences. Comptes Rendus. v.192. p.1598-1600. June 15, 1931.
Experimental infection with fowl cholera through the air. Author's experiments show that under favorable conditions, such as often occur in poultry houses, fowl cholera may be transmitted through the air.

b. Brooders.

Dougherty, J. E. and Moses, B. D. Relation of ventilation in an electric brooder to health and growth of chicks. Poultry Science. v.12. p.141-143. March 1933.

Fairbanks, F. L., and Goodman, A. M. Ventilation of poultry laying houses. Ithaca, N. Y., 1938. 24 p. Cornell University. State College of Agriculture. Extension Service. Bulletin no.315.

Stiles, G. W. Jr. Supply enough frosh air in the brooder house. Poultry Tribune. (Eastern edition). v.43. p.8, 62-64. March 1937.

c. Cages.

Althouse, S. L. Getting down to this business of ventilation. Poultry Item. v.32. p.11, 16-18, 45. November 1929. Discussion of Shenandoah type.

Huttar, J. C., Fairbanks, F. L., and Botsford, H. E. Ventilation of poultry houses for laying and breeding hens. Ithaca, N. Y., 1933. 48 p. Cornell University. Agricultural Experiment Station. Bulletin no.558. Two 20 by 20 ft. pens were used in the studies, these being constructed as one long building with an 8 by 20 ft. observation and feed room between them. One pen was constructed according to the regular plans of the Cornell laying house, whereas the other differed in that it was insulated inside with Celotex, the center curtain openings were fitted with windows, and a Rutherford type ventilation system was installed. While egg production was good in both pens, it was much larger in the insulated pen. The 6 years' average figures for the two pens showed no significant difference in the quantity of feed required to produce one dozen eggs.

Peterson, J. E. Winter air conditioning for modern poultry house. American Artisan. v.109. p.52-55. August 1940. Also, Poultry Item. v.44. p.8-9, 42-43. February 1941.

d. Poultry Houses.

Anonymous. Air conditioning a poultry feeding room. Heating and Ventilating. v.32. p.36. March 1935.

Carver, J. S. Ventilation and its relation to wet litter. Pullman, Wash., 1925. p.37-38. Washington. Agricultural Experiment Station. Bulletin no.196. The amount of moisture in the litter in the straw loft pen was very heavy, being often 30 percent within a week's time. The straw loft averaged about 12 percent moisture content, and it appeared that the straw in the loft did not absorb any moisture from the litter.

Giese, H. Method of research as applied to a project on the air requirements of poultry. Agricultural Engineering. v.7. p.20-24, 26. January 1926. In a contribution from the Iowa Experiment Station, a critical analysis is presented of air requirements of poultry as a basis for a research project in the development of poultry housing equipment. The analysis is based upon a project now under way in the agricultural engineering division of the station. An extensive bibliography is appended.

Huttar, J. C., Fairbanks, F. L., and Botsford, H. E. Ventilation of poultry houses for laying and breeding hens. Ithaca, N. Y., 1933. 48 p. Cornell University. Agricultural Experiment Station. Bulletin no.558.

Richardson, H. L. and Huber, M. G. Poultry house insulation and ventilation. Revised edition. Orono, Maine, 1937. 16 p. Maine University. College of Agriculture. Extension Service. Bulletin no.216.

Ruckman, J. H. Decreased death rate of poultry represents large profit--- proper air conditions an aid. Heating, Piping and Air Conditioning. v.2. p.1008-1012. December 1930. It has been found that at temperatures below 60° F. the consumption of food is increased per pound of weight gained, and at a temperature of 65° F. the poultry while healthy lost appetite and fail to gain.

Smith, L. J. Poultry house ventilation in Washington. Agricultural Engineering. v.9. p.83-84. March 1928. The birds in the ventilated pens laid 1.7 percent more eggs in December, 5 percent more in January, 0.3 percent more in February, and 6.8 percent more in March than the birds in unventilated pens.

12. Poultry Houses.

a. Space Requirements.

Bobby, F. C. Influence of confinement on the production of White Leghorn pullets. Harper Adams Utility Poultry Journal. v.13. p.471-477. 1927-28. In this study at the Harper Adams Agricultural College, England, 3 lots of 40 Leghorn pullets were observed for a period of 40 weeks beginning September '20. During October, all birds had access to grass runs, and 1 lot, used as a check, was allowed access to the run throughout the test. On October 30, 1 lot was confined in a house with a board front and ordinary glass in the windows, while another lot was confined in a house with a wire netting open front. The latter lot was allowed to go out into the grass runs again on March 15. The other lot was divided into 2 groups at this date, and 1 group was fed 2 percent of cod-liver oil. Neither of the divided groups was allowed outdoors. The feeding with the above exception was the same in all lots. The birds in the check lot laid more eggs than any of the other lots, the advantage being gained during the winter months. Production in the lot confined in the open front house rose markedly when the birds were allowed outdoors. The difference in the production of the above lots during February and March is statistically significant. Production in the lot confined in the glass front house was quite low.

Callenbach, E. W. and Knandel, H. C. Hen batteries. College Station, Pa., 1935. 19 p. Pennsylvania. Agricultural Experiment Station. Bulletin no.314.

Charles, T. B. and Knandel, H. C. Rearing chicks in confinement. State College, Pa., 1928. 12 p. Pennsylvania. Agricultural Experiment Station. Bulletin no.218.

Doyle, L. P., Mathews, F. P., and Roberts, R. E. Does rearing chicks in confinement affect the red cell or hemoglobin content of their blood? Poultry Science. v.9. p.6-12. November 1929.

Kennard, D. C. and Chamberlin, V. D. Batteries for chickens. Wooster, O., 1933. p.63-70. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.162.

_____ Care of layers in batteries. Wooster, O., 1939. p.29-34. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.197.

_____ Shall the layers be confined? Wooster, O., 1929. p.156-160. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.140.

_____ and Chamberlin, V. D. Some observations on caged layers. Wooster, O., 1932. p.35-41. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.155. Some of the results of preliminary tests begun in 1924 with layers kept in wire cages are discussed. In addition new work in progress is outlined in relation to feeding, size of cages, losses of eggs from breakage, and arrangement of quarters.

_____ Sun yards for chickens. Wooster, O., 1932. p.44-46. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.155. The advantage of sun yards and sun porches and methods of construction are described in this article.

Thompson, R. B., Schnetzler, E. E. and Albright, W. P. Growing turkeys in confinement. Stillwater, Okla., 1932. 16 p. Oklahoma. Agricultural Experiment Station. Bulletin no.202. Observations covering a period of 4 years on growing turkeys in confinement, together with recommendations on feeding, housing, selection and management of breeders, and hatching and brooding of poults are included in this bulletin.

Thompson, W. C. Management of laying hens in cages. U. S. Egg and Poultry Magazine. v.42. p.24-27. January 1936.

b. Insulation.

Anonymous. Poultry house insulation. Wisconsin Agriculturist. v.59. p.18. February 6, 1932. Poultry house insulation. Three-story house for egg production.

Hammond, J. C., Hendricks, W. A., and Titus, H. W. Effect of percentage of protein in the diet on growth and feed-utilization of male chickens. Journal of Agricultural Research. v.56. p.791-810. June 1, 1938.

North, M. O. Wyoming straw-loft poultry house. Laramie, Wyo., 1935. 15 p. Wyoming. Agricultural Experiment Station. Bulletin no.211. Practical information is given on the construction of the Wyoming straw-loft poultry house, together with drawings and a list of materials for a 20 by 20ft. section.

Scott, J. C. Forced ventilation and temperature control for individual laying cage poultry houses. Rural Electrification Exchange. v.2. p.57, 66. Third Quarter, 1939.

c. Designs, Farm Types.

Charles, T. B. and Tepper, A. E. Poultry housing. Durham, N. H., 1932. 19 p. New Hampshire. College of Agriculture and Mechanic Arts. Extension Service. Circular no.138. Practical information is given on the planning and construction of poultry houses to meet the conditions and requirements of New Hampshire. Working drawings of suggested structures are given, together with bills of materials.

Dougherty, J. E., and Belton, H. L. Poultry houses and equipment. Revised edition. Berkeley, Cal., 1933. 76 p. California. Agricultural Experiment Station. Bulletin no. 476.

Halpin, J. G., Hayes, J. B., and Witzel, S. A. Colony houses for poultry. Revised edition. Madison, Wis., 1926. 14 p. Wisconsin. College of Agriculture. Extension Service. Circular no.208.

Herner, M. C. Poultry houses for Manitoba. Winnipeg, Manitoba, 1936. 31 p. Manitoba. Department of Agriculture, Dairy and Food. Extension Service. Bulletin no.103. Information is presented on the planning and construction of poultry houses adapted to conditions in Manitoba, together with working drawings and building material for specific structures.

Jones, R. E. Connecticut summer shelter. Storrs, Conn., 1937. 8 p. Connecticut. State College. Extension Service. Bulletin no.241.

_____ Connecticut 24' x 24' poultry house. Storrs, Conn., 1939. 42 p. Connecticut. State College. Extension Service. Bulletin no.284.

Jull, M. A. Houseless method of poultry keeping. Poultry Science. v.10. p.32-36. November 1930.

_____ and Lee, A. R. Poultry houses and fixtures. Revised edition. Washington, D. C., 1934. 34 p. U. S. Department of Agriculture. Farmers' Bulletin no.1554.

Kelley, J. B. and Martin, J. H. Housing farm poultry. Revised edition. Lexington, Ky., 1936. 30 p. Kentucky. Agricultural Experiment Station. Circular no.107.

Knowlton, F. L., Cosby, H. E. and Price, F. E. Poultry housing. Corvallis, Ore., 1935. 48 p. Oregon. State College. Extension Service. Bulletin no.480.

Lunn, A. G., and Gilmore, W. J. O.S.C. 400-hen laying house. Corvallis, Ore., 1932. 1 p. Oregon. State College. Extension Service. Bulletin no.447. Complete working drawings for this structure are given, together with practical information on its construction and a bill of materials.

Mehrhof, N. R. and Rogers, Frazier. Houses and equipment for poultry in Florida. Gainesville, Fla., 1936. 38 p. Florida. University. Agricultural Extension Service. Bulletin no.77.

Richardson, H. L. Poultry houses. Orono, Me., 1936. 16 p. Maine. College of Agriculture. Extension Service. Bulletin no.218.

Sanctuary, W. C. Poultry housing. Amherst, Mass., 1938. 24 p. Massachusetts. State College. Extension Service. Leaflet no.145.

Vernon, W. M., Whitfield, W. R. and Van Vlack, C. H. Iowa straw loft poultry house. 2d. edition. Ames, Ia., 1936. 15 p. Iowa. College of Agriculture and Mechanic Arts. Extension Department. Circular no.146.

d. Multi-story, Commercial Houses.

Gross, E. R. and Besley, H. E. New Jersey multiple unit laying house and bill of material. New Brunswick, N. J., 1934. 15 p. New Jersey. Agricultural Experiment Station. Circular no.318.

e. Floors.

Beresford, Hobart. Floor heating for brooder houses. Agricultural Engineering. v.13. p.240. September 1932.

Cram, E. B. Campaigns against poultry parasites. U. S. Egg and Poultry Magazine. v.40. p.30-33, 62, 63. March 1934.

_____. Strategy for war on poultry parasites. Eastern States Co-operator. v.10. p.4-5, 20, 26. January 1934.

Waite, R. H. Poultry house floor. College Park, Md., 1932. 63-78 p. Maryland. Agricultural Experiment Station. Bulletin no.334. A moisture test was made in which 25 gallons of water was poured daily through a small hole in the straw-insulated floor for 16 consecutive days in weather of late winter. There were no signs of dampness on the surface of the floor at any time. At the end of approximately three years, it was found that the straw had rotted out leaving a dead air space underneath the cement. A straw-insulated floor was found to dry very quickly, which is of special advantage in late fall construction. Directions for construction and amount of material required are given.

13. House Equipment.

Kennard, D. C. and Chamberlin, V. D. Housing, labor-saving equipment, and management procedures for layers. Wooster, O., 1935. 108-112 p. Ohio. Agricultural Experiment Station. Bimonthly Bulletin no.174. In this article, the authors discuss the housing, ventilation, window space, labor-saving equipment, and advantages of different shapes of rooms for laying birds.

---. Time and labor-saving equipment for the laying house. Wooster, O., 1938. 8 p. Ohio. Agricultural Experiment Station. Special Circular no.51. Satisfactory simple types of feeders, watering devices, box nests, dropping pits, self-closing partition doors, and an automatic time-switch device for lighting the laying house are described and illustrated.

Mehrhof, N. R. and Rogers, F. Houses and equipment for poultry in Florida. Gainesville, Fla., 1934. 38 p. Florida. University. Agricultural Extension Service. Bulletin no. 77.

a. Waterers.

Eriksen, Sivert. Use of potassium permanganate in the drinking water for poultry. American Veterinary Medical Association. Journal. v.67. p.496-501. July 1925. Investigations show that potassium permanganate is very efficient as a purifier of drinking water for poultry. Organic material oxidizes it rapidly, but the change of color with oxidation makes it a self-indicator. Potassium permanganate compares favorably with other drugs, growing chicks not being injured by its use in strong dilution. When used with sour milk it does not produce harmful substances. Slow poison.

Heywang, B. W. Effect of cold drinking water on chick growth and yolk absorption. Poultry Science. v.19. p.201-204. May 1940. Inconclusive either on amount or effect.

---. Water consumption of hens. Poultry Science. v.22. p.184-187. March 1941.

Hienton, T. E. and Carrick, C. W. Experiments with electric water heaters for poultry. Lafayette, Ind., 1932. 12 p. Indiana. Agricultural Experiment Station. Bulletin no.367. Experiments are reported which showed that electric heaters of proper capacity offer a satisfactory method for preventing freezing in poultry drinking vessels.

Kable, G. W., and Fox, F. E. Electric water heaters for poultry. Corvallis, Ore., 1927. 15 p. Oregon. Agricultural Experiment Station. Circular no.81.

b. Heaters and Heating.

Anonymous. Pen heating. Brookings, S. D., 1930. p.30. South Dakota. Agricultural Experiment Station. Report, 1930.
A pen of laying hens whose quarters were heated so that the temperature was above freezing at all times ate less feed and laid more eggs than a similar pen in unheated quarters. After deducting the cost of fuel and feed from the sale of the eggs, there was a balance of $3.54 over production cost in favor of the heated quarters.

Card, C. G. Artificial heat in poultry houses. East Lansing, Mich., 1930. p.228-229. Michigan. Agricultural Experiment Station. Report, 1930.

Conrad, R. M. Effect of high temperature on blood calcium of the laying hen. Poultry Science. v.18. p.327-329. July 1939.

Hall, G. E. External temperature as a factor in the production of diarrhea in young chickens. Poultry Science. v.11. p.250-254. July 1932.

Lee, C. E. and others. Effect of supplementary heat on egg production, feed consumption, amount of litter required, and net flock income. Poultry Science. v.16. p.267-273. July 1937.
Based on 1 year's results with three pens of White Leghorns and one pen of New Hampshires housed in artificially heated houses for a 120-day winter period (average temperature about 40° F.) as compared with a similar number of pens in insulated unheated houses under New York conditions, it is tentatively concluded that annual egg production of both breeds is lowered by the use of supplementary artificial heat. Complete data on egg production, feed, labor, litter, and heating costs and net income are presented.

---. Effect of supplementary heat on egg production, feed consumption, amount of litter required, and net flock income. Part 2. Poultry Science. v.18. p.359-368. September 1939.

Shoup, G. R. and Shoup, Mrs. G. R. [Experiments with poultry at the Western Washington Station.] Puyallup, Wash., 1928. p.24-40. Western Washington. Agricultural Experiment Station. Bulletin 10-W.
Keeping straw litter dry by forced circulation of heated air.

Store, J. B. Electric water heaters for poultry. Pennsylvania State Farmer. v.27. p.10,13. October 1933.
Table gives data and results on electric water heater.

Warren, D. C. and Schnepel, R. L. Effect of air temperature on egg shell thickness in the fowl. Poultry Science. v.19. p.67-72. January 1940.

14. Manure and Litter.

a. Manure Storage and Disposal.

Brown, B. E. Pulverized poultry manure and poultry manure tankage. U. S. Golf Association. Green section. Bulletin. v.8. p.208-209. October 1928.

Marsden, S. J. Manure production of adult turkeys. Poultry Science. v.17. p.423-424. September 1938.

Pearl, Raymond. Poultry notes 1911-1913. Orono, Maine, 1913. 28 p. Maine. Agricultural Experiment Station. Bulletin no.216. Preservation of hen manure.

Stoker, G. L., Tingey, D. C. and Evans, R. J. Effect of different methods of storing chicken manure on the viability of certain weed seeds. American Society of Agronomy. Journal. v.26. p.600-609. July 1934. When stored at the Utah Experiment Station in wire containers in chicken manure in different ways for various periods, and removed and germinated at intervals of from 10 days to 4 months, the viability of morning-glory seed was not destroyed. Whitetop and Russian knapweed seeds lost their viability after being in moist loose manure for 20 days, or after being in moist compacted manure for 1 month but in unmoistened piles their viability was not destroyed completely at the end of 4 months.

Thompson, W. C. Poultry litters. New Brunswick, N. J., 1938. 4 p. New Jersey. Agricultural Experiment Station. Hints to Poultrymen. no.25. A 10-point test is described which may be applied to determine the desirability of various poultry litters.

b. Litters.

Carver, J. S. Ventilation and its relation to wet litter. Pullman, Wash., 1925. p.37-38. Washington. Agricultural Experiment Station. Bulletin no.196.

Dann, A. B. Wet litter in the poultry house. Poultry Science. v.3. p.15-19. October-November 1923.

Kennard, D. C. and Nettleton, L. B. Litter problem. Wooster, Ohio 1926. p.229-231. Ohio. Agricultural Experiment Station. Bimonthly Bulletin v.11, no.4. Essentially a discussion of the use of straw, shavings, peat, and slag as litter for poultry houses, based on the results of tests at the station.

Miller, M. W. Wet litter in poultry houses. Agricultural Engineering. v.13. p.238-239. September 1932.

15. Miscellaneous Fowls.

a. Turkeys.

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